PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Midterm Examination: Semester II
Date: December 21, 2009
Subject: 226-301 Advanced Manufacturing Technology

Academic Year: 2009
Time: 9:00-12:00
Room: หัวหุ่นยนต์, R200

ทุจริตในการสอบ โทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และ พักการเรียน 1 ภาคการศึกษา

INSTRUCTION:

1) There are 11 questions in 5 pages.
2) Attempt all 11 questions in the answer-book provided.
3) An A4-note with own-hand writing on both sides and a calculator are allowed.
4) Total score is 90.

Question	Full Score	Assigned Score
Q1	10	
Q2	5	
Q3	10	
Q4	10	
Q5	5	
Q6	5	
Q7	5	
Q8	10	
Q9	10	
Q10	10	
Q11	10	
Total	**90**	

Assoc. Prof. Somchai Chuchom

Q1 Specify the global trends that may affect today's business. Also demonstrate the effects of Demographic Patterns on food industry of Thailand. (10 points)

Q2 Ceramic and cermet cutting tools have certain advantages over carbide tools. Why, then, are they not completely replacing carbide tools? (5 points)

Q3 Consider the special shapes of workpieces as shown in Figure 1, their details are also listed in a) to f) of Table 1. Select the most appropriate non-traditional machining processes for each shape and give your reasons. (10 points)

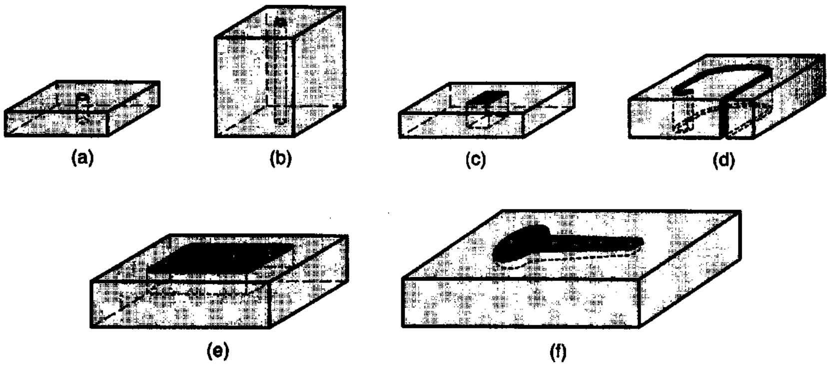

Figure 1

Table 1

	Details	Appropriate non-traditional Machining Processes /reasons
a)	Very small holes below 0.125 mm in diameter	
b)	Holes with large depth-to-diameter ratios (d/D > 20)	
c)	Holes that are not round	
d)	Narrow slots in slabs and plates of various materials, the slots are not necessarily straight	
e)	Shallow pockets and surface details in flat parts	
f)	Special contoured shapes for mold and die applications	

Q4 Compare the machining characteristics of the prominent non-traditional processes to conventional processes. Specify only letter 'A, B, C, or D' in the table, where A = excellent, B = good, C = fair, and D = poor. (10 points)

	Non-traditional Processes						Conventional Processes	
Characteristics	*USM*	*WJM*	*ECM*	*EDM*	*EBM*	*LBM*	Milling	Grinding
Material removal rates								
Dimensional control								
Surface finish								
Surface damage								

Q5 Highlight the functions of dielectric fluid used in the wire-cut EDM process (5 points)

Q6 Both the electrode wear and the material removal rate in wire-cut EDM process depend on what factors? (5 points)

Q7 Ultrasonic machining is best suited for hard and brittle materials, explain why? (5 points)

Q8 Why is high-speed cutting important? What should be considered when applying high-speed machining regarding to a) the machine tools and b) the cutting tools? (10 points)

Q9 Choose one of the advanced manufacturing processes covered in the class, show what you know about it and specify a part or product that is most appropriate produced by this chosen process. (10 points)

Q10 A furniture company that makes upholstered chairs and sofas must cut large quantities of fabrics. Many of these fabrics are strong and wear resistant, which properties make them difficult to cut. What non-traditional processes would you recommend to the company for this application? Justify your answer by indicating the characteristics of the process that make it attractive. (10 point)

Q11 Read the article '*Printed Circuit Boards*' and summarize the technologies you have learned from it. (10 points)

Printed Circuit Boards

Packaged integrated circuits seldom are used alone; rather, they usually are combined with other ICs to serve as building blocks of a yet larger system. A *printed circuit board* (PCB) is the substrate for the final interconnections among all of the completed chips and serves as the communication link between the outside world and the microelectronic circuitry within each packaged IC. In addition to the ICs, circuit boards also usually contain discrete circuit components (such as resistors and capacitors) which take up too much "real estate" on the limited silicon surface, have special power-dissipation requirements, or cannot be implemented on a chip. Other common discrete components are inductors (which cannot be integrated onto the silicon surface), high-performance transistors, large capacitors, precision resistors, and crystals (for frequency control).

A printed circuit board is basically a plastic (resin) material containing several layers of copper foil (Fig. 28.29). *Single-sided* PCBs have copper tracks on only one side of an insulating substrate; *double-sided* boards have copper tracks on both sides. Multilayered boards also can be constructed from alternating layers of copper and insulator. Single-sided boards are the simplest form of circuit board.

Double-sided boards usually must have locations where electrical connectivity is established between the features on both sides of the board. This is accomplished with vias, as shown in Fig. 28.29. Multilayered boards can have partial, buried, or through-hole vias to allow for extremely flexible PCBs. Double-sided and multilayered boards are beneficial, because IC packages can be bonded to both sides of the board, allowing for more compact designs.

The insulating material is usually an epoxy resin 0.25 to 3 mm thick reinforced with an epoxy/glass fiber and is referred to as E-glass . The assembly is produced by impregnating sheets of glass fiber with epoxy and pressing the layers together between hot plates or rolls. The heat and pressure cure the board, resulting in a stiff and strong basis for printed circuit boards.

Boards are sheared to a desired size, and about 3-mm diameter locating holes then are drilled or punched into the board corners to permit alignment and proper location of the board within the chip-insertion machines. Holes for vias and connections are punched or produced through CNC drilling; stacks of boards can be drilled simultaneously to increase production rates.

The conductive patterns on circuit boards are defined by lithography, although originally, they were produced through screen-printing technologies—hence the term

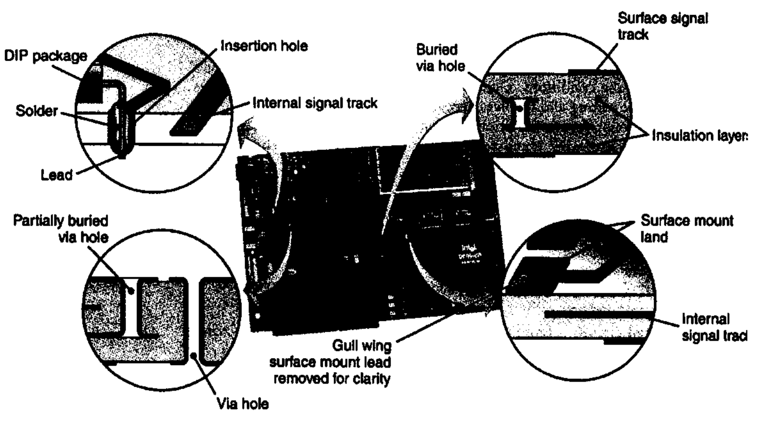

FIGURE 28.29 Printed circuit board structures and design features.

printed circuit board or *printed wiring board* (PWB). In the *subtractive method*, a copper foil is bonded to the circuit board. The desired pattern on the board is defined by a positive mask developed through photolithography, and the remaining copper is removed through wet etching. In the *additive method*, a negative mask is placed directly onto an insulator substrate to define the desired shape. Electroless plating and electroplating of copper serve to define the connections, tracks, and lands on the circuit board.

The ICs and other discrete components then are fastened to the board by soldering. This is the final step in making both the integrated circuits and the microelectronic devices they contain into larger systems through connections on printed circuit boards. *Wave soldering* and *reflow paste soldering* (see Section 32.3 and Example 32.1) are the preferred methods of soldering ICs onto circuit boards.

Some of the design considerations in laying out PCBs are the following:

1. Wave soldering should be used only on one side of the board; thus, all through-hole mounted components should be inserted from the same side of the board. Surface-mount devices placed on the insertion side of the board must be reflow soldered in place; surface-mount devices on the lead side can be wave soldered.
2. To allow good solder flow in wave soldering, IC packages should be laid out carefully on the printed circuit board. Inserting the packages in the same direction is advantageous for automated placing, because random orientations can cause problems in the flow of solder across all of the connections.
3. The spacing of ICs is determined mainly by the need to remove heat during the operation. Sufficient clearance between packages and adjacent boards is required to allow forced air flow and heat convection.
4. There also should be sufficient space around each IC package to allow for reworking and repairing without disturbing adjacent devices.